123,906

PATENT SPECIFICATION

Application Date, May 31, 1918. No. 9021/18.
Complete Left, Nov. 28, 1918.
Complete Accepted, Mar. 13, 1919.

PROVISIONAL SPECIFICATION.

Improvements in or pertaining to Windings in Electrical Apparatus.

We, THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, of Maxwell House, Arundel Street, Strand, London, W.C. 2, in the County of Middlesex, and PERCY WILLIAM SCHOLEFIELD, of the same address, Electrical Engineers, do hereby declare the nature of this invention to be as follows:—

This invention has reference to windings of electrical apparatus wherein it is desirable to avoid joints in the winding and to secure efficient and durable insulation between the several layers.

The invention is particularly suitable for high tension windings, such for instance, as the windings of alternating current transformers, and is adapted to minimise shrinkage in the windings whilst the apparatus is in operation, to permit or facilitate the introduction of oil insulation between the several layers, to enable the tappings to be more easily taken off from the high tension windings for regulation or other purpose, and generally to simplify the process of winding and reduce the cost of insulation whilst at the same time greatly lessening and substantially eliminating the risk of breakdown of the insulation between adjacent turns or layers of windings.

On transformers for example, in one construction, the high tension windings comprise several sections per phase, each section being composed of several layers and several turns per layer thus necessitating several joints in the winding between the sections and a large amount of insulating material between layers and on the coils, causing considerable shrinkage in use, necessitating the provision of devices for taking up such shrinkage that may be automatic or non-automatic by means, in the latter case, of spanners and the like, and moreover practically precluding the provision of oil circulation between successive layers of the winding, which are separated by flexible or plastic insulating materials only. Since large potential differences frequently occur between these layers, there is constant danger of its causing breakdown between the layers through the collapse of the said insulation.

Now according to the present invention a winding for electrical apparatus such for instance as the high tension winding of a monophase transformer or a similar winding of one phase of a polyphase transformer, comprising it may be insulation coated copper wire, is wound continuously in the requisite number of successive layers between each whereof is interposed a layer of hard insulating material in such manner as to provide a space through which oil can be circulated.

In carrying out the invention the continuous winding, is, conveniently, arranged on several insulating tubes or layers of insulation, the first layer of winding being put direct on to the tube which usually separates the primary

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from the secondary winding. On completion of the winding on this tube, insulating strips are disposed around the same at suitable intervals apart and around these a second tube or insulation layer is arranged, the space between the two forming an oil circulation path for the first layer of winding. Conveniently, this tube has at one end a slot through which the wire from the first layer is passed so as to wind the second layer on to this insulation, and in a similar manner any number of successive layers can be wound with intermediate similar provision for oil circulation paths.

The complete winding or winding per phase can by this method be done in the winding lathe as a single operation, thus cheapening the present system of separately winding different sections, whilst, in addition, the complete winding in monophase work or the winding per phase in polyphase work can be simply handled in the shop as one piece, thus saving cost in erection and dispensing with a large amount of separate handling which occurs in the present winding practice where there are several sections per phase. This simplification of handling is in itself a great advantage.

The provision of oil circulation paths between the layers keeps the whole of the windings at practically a uniform temperature so that a higher rating can be obtained, whilst in view of the more efficient cooling, the oil circulating between the layers keeps the covering on the conductor in condition and prevents its deterioration. The oil would in itself under normal conditions constitute a sufficient insulation so that in conjunction with the hard insulating tube a very large factor of safety is provided thus rendering a breakdown of insulation between the layers, even under abnormal conditions, practically impossible.

A winding according to the present invention lends itself to the provision with facility of tappings, when such are required to be taken from a high tension winding for regulation of voltage or transformation ratio or other reasons. Ordinarily, such tappings form part of one of the sections, and as a result invariably involve a weak spot where the tapping is brought out for connection to the terminals. In the improved method of winding herein described, however, the long and uninterrupted outer layer provides ample facility for taking off at needful points tappings for regulation extending over a very considerable range of voltage, so that in practice all requisite tappings can be placed on the said last layer and can easily be made by looping out, thus securing the strongest possible arrangement both mechanically and electrically.

Dated this 31st day of May, 1918.

For the Applicants,
LLOYD WISE & Co.,
10, New Court, Lincoln's Inn, London, W.C. 2,
Chartered Patent Agents.

COMPLETE SPECIFICATION.

Improvements in or pertaining to Windings in Electrical Apparatus.

We, THE BRUSH ELECTRICAL ENGINEERING COMPANY, LIMITED, of Maxwell House, Arundel Street, Strand, London, W.C. 2, in the County of Middlesex, and PERCY WILLIAM SCHOLEFIELD, of the same address, Electrical Engineers, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention has reference to windings of electrical apparatus wherein it

is desirable to avoid joints in the winding and to secure efficient and durable insulation between the several layers.

The invention is particularly suitable for high tension windings, such for instance, as the windings of alternating current transformers, and is adapted to minimise shrinkage in the windings whilst the apparatus is in operation, to permit or facilitate the introduction of oil insulation between the several layers, to enable the tappings to be more easily taken off from the high tension windings for regulation or other purposes, and generally to simplify the process of winding and reduce the cost of insulation whilst at the same time greatly lessening and substantially eliminating the risk of breakdown of the insulation between adjacent turns or layers of windings.

On transformers for example, in one construction, the high tension windings comprise several sections per phase, each section being composed of several layers and several turns per layer thus necessitating several joints in the winding between the sections and a large amount of insulating material between layers and on the coils, causing considerable shrinkage in use, necessitating the provision of devices for taking up such shrinkage that may be automatic or non-automatic by means, in the latter case, of spanners and the like, and moreover practically precluding the provision of oil circulation between successive layers of the winding, which are separated by flexible or plastic insulating materials only. Since large potential differences frequently occur between these layers, there is constant danger of its causing breakdown between the layers through the collapse of the said insulation.

Now according to the present invention a winding for electrical apparatus such for instance as the high tension winding of a monophase transformer or a similar winding of one phase of a polyphase transformer, comprising it may be insulation coated copper wire, is wound continuously in the requisite number of successive layers between which are interposed layers of hard insulating material in such manner as to provide a space into or through which oil can be introduced or circulated.

In the accompanying drawings, which illustrate the invention by way of example, as applied to the high tension winding of a transformer, Figs. 1 and 2 are diagrammatic representations of the apparatus in longitudinal and transverse section respectively, Fig. 3 is a diagrammatic end view on a reduced scale, illustrating the method of taking off tappings by looping out, and Figs. 4 to 11 are subsidiary views illustrating various alternative constructions and forms of insulating tubes.

Referring to the drawings:—

The continuous winding, is conveniently arranged on several layers of insulation, as for instance tubes, the first layer 1 of winding being put direct on to the tube 2 which usually surrounds the inner winding, not shown, and separates it from the outer winding. On completion of the first layer 1 of winding on this tube 2, insulating distance pieces, as strips 3, which may be plain, as indicated in the upper portion of Fig. 2 or corrugated, as indicated in the lower portion of the said figure, or of other suitable form, are disposed around the said first layer 1 of winding at suitable intervals and around these a second tube 4 is arranged, the space 5 between successive strips serving for introducing, and, it may be, circulating oil for the first layer 1 of winding. Conveniently this tube 4 has at one end a slot 6, or, it may be, an equivalent hole, through which the wire from the first layer 1 of winding is passed so as to wind the second layer 7 on to this insulation 4, and in a similar manner any number of successive layers can be thus continuously wound; the example illustrated in Figs. 1 and 2 comprising a third layer 8 and insulating tube 9 with a slot or hole 10 for the passage of the winding from its second to its third layer, with intermediate similar provision comprising strips 11 and intervening space 12 for oil.

The complete winding or winding per phase can, if the form admits, be

done by this method in the winding lathe as a single operation, thus cheapening the present system of separately winding different sections, whilst, in addition, the complete winding in monophase work or the winding per phase in polyphase work can be simply handled in the shop as one piece, thus saving cost in erection and dispensing with a large amount of separate handling which occurs in the present winding practice, where there are several sections per phase. This simplification of handling is in itself a great advantage.

The insulating tubes may each be formed solid as a single piece, as shown, in Fig. 4, as a split tube with butt joint as shown in Fig. 5, or with overlap joint as shown in Fig. 6, or they may each be composed of two or more segments having butt joints as illustrated in Fig. 7 or overlap joints as illustrated in Fig. 8.

Again whilst desirable for facility of winding, it is not essential that the tubes and windings should be of circular form. They may, for instance, be of the forms shown in Figs. 9 to 11 inclusive.

The provision of oil spaces such as 5 and 12 between the layers of winding keeps or enables the whole of the windings to be kept at practically a uniform temperature so that a higher rating can be obtained, whilst in view of the more efficient cooling, the oil between the layers keeps the covering on the conductor in condition and prevents its deterioration. The oil would in itself under normal conditions constitute a sufficient insulation so that in conjunction with the hard insulating tube a very large factor of safety is provided thus rendering breakdown of insulation between the layers, even under abnormal conditions, practically impossible.

A winding according to the present invention lends itself to the provision with facility of tappings, when such are required to be taken from a high tension winding for regulation of voltage or transformation ratio or other reasons. Ordinarily, such tappings form part of one of the sections, and as a result invariably involve a weak spot where the tapping is brought out for connection to the terminals. In the improved method of winding herein described, however, the long and uninterrupted outer layer 8 provides ample facility for taking off at needful points, as illustrated in Figs. 1 and 3, tappings 13 for regulation extending over a very considerable range of voltage so that in practice all requisite tappings can usually be placed on the said last layer and can easily be made by looping out, thus securing the strongest possible arrangement both mechanically and electrically. When, however, it is necessary or desirable to provide for tappings at other points in the winding, this can be done by joining a conductor to the desired turn of the winding or by arranging a loop therein after the manner illustrated in Fig. 3, the conductor or loop being then brought up through an oil space to the end of the coil, and connected up according to requirement.

It will be seen that the winding or each winding when formed as described consists from its start 14 to its finish 15, of a single unbroken wire or strip.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A method of winding for electrical purposes which consists in winding wire with insulation continuously in successive layers, and so interposing hard insulating material between these layers as to provide an oil space, substantially as described.

2. In effecting electrical winding according to the preceding claim, winding the successive layers of winding direct on to insulating tubes and arranging insulating distance pieces around each winding at suitable intervals the spaces between successive distance pieces forming oil insulation spaces for the adjacent layers, substantially as described.

3. In electrical apparatus an insulated winding disposed continuously in

successive layers between which layers of insulating material are interposed so as to provide oil insulation spaces substantially as described.

4. An electrical winding according to Claim 3 wherein each layer of winding is wound directly upon an insulating tube, substantially as described.

5. An electrical winding according to Claim 3 or Claim 4, wherein the tappings are taken off from the outer layer, preferably by looping out, substantially as described.

6. Electrical windings constructed substantially as described with reference to and shown in the accompanying drawings.

Dated this 28th day of November, 1918.

For the Applicants,

LLOYD WISE & Co.,
10, New Court, Lincoln's Inn, London, W.C. 2,
Chartered Patent Agents.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1919

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 2.

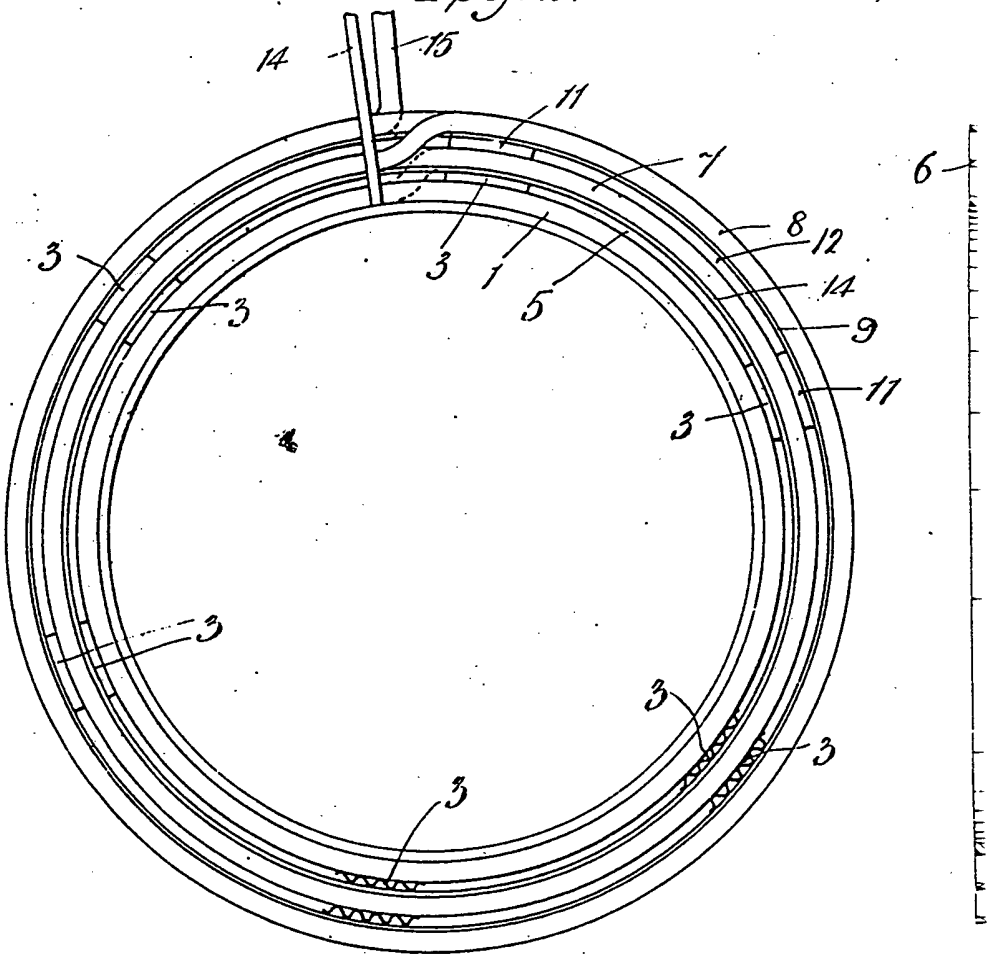


Fig. 4. Fig. 5.

Fig. 6. Fig. 7. Fig. 8.

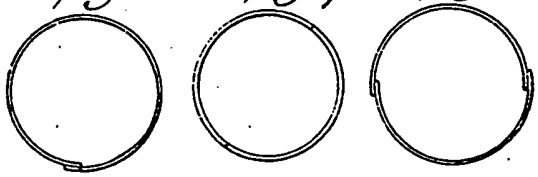


Fig. 1.

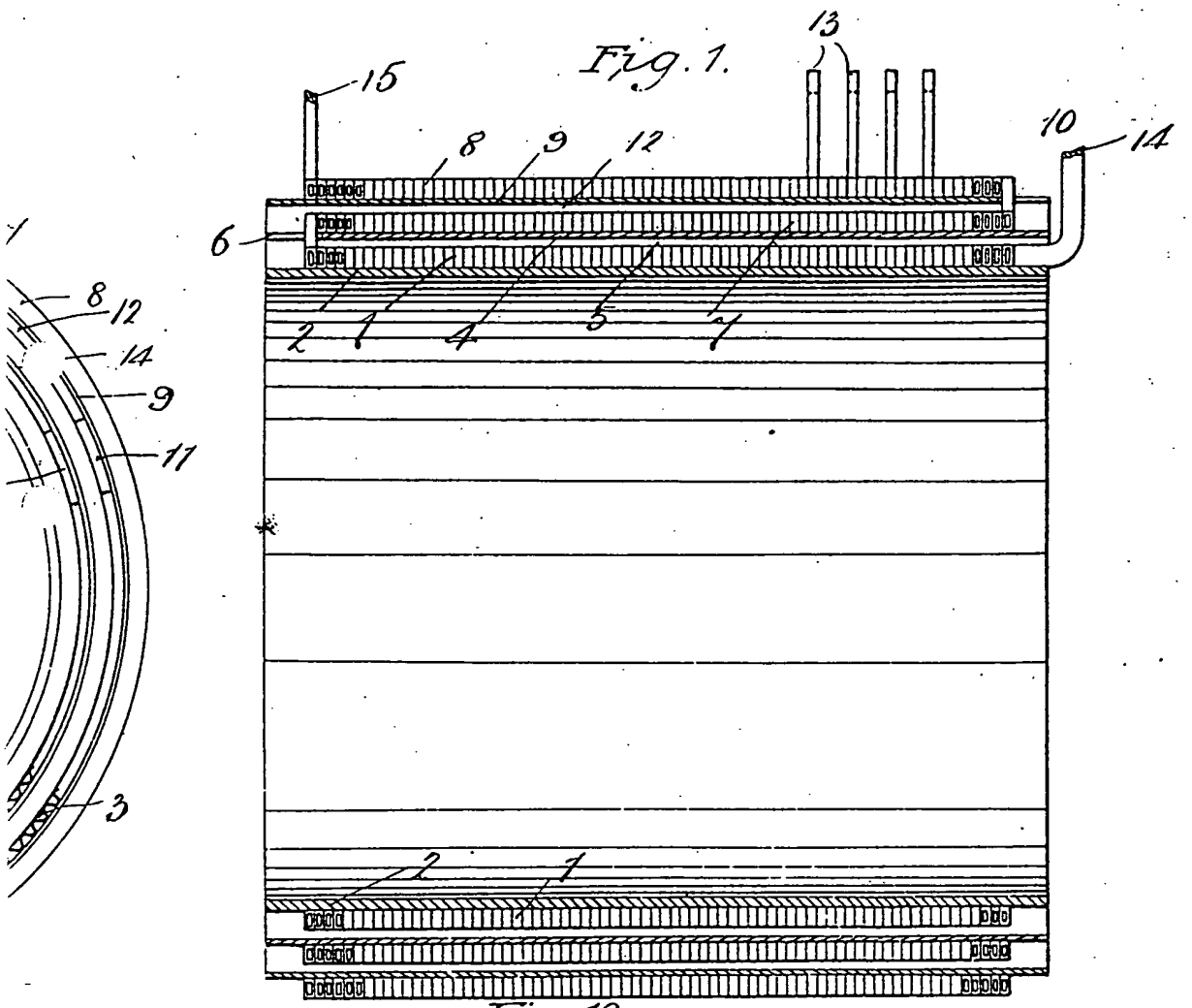


Fig. 10.

Fig. 9.

Fig. 11.

Fig. 3.

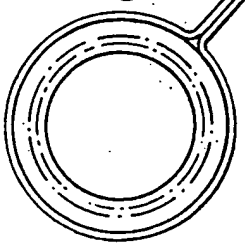
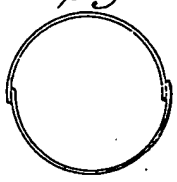


Fig. 8.



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